

CLAIMS

- [1] A solar cell comprising:
a substrate;
a conductive film formed on the substrate;
5 a compound semiconductor layer formed on the conductive film, the compound semiconductor layer including a p-type semiconductor crystal containing an element of Group Ib, an element of Group IIIb, and an element of Group VIb;
a n-type window layer formed on the compound semiconductor layer,
10 the n-type window layer having an aperture; and
a n-type transparent conductive film formed on the n-type window layer and on a portion of the compound semiconductor layer at the aperture of the n-type window layer,
wherein
15 the compound semiconductor layer includes a high-resistance part, the high-resistance part being located in a portion of the compound semiconductor layer in the vicinity of a surface thereof on a side opposite to the conductive film, the high-resistance part containing a n-type impurity doped in the p-type semiconductor crystal, and
20 the high-resistance part is located under the aperture of the n-type window layer.
- [2] The solar cell according to claim 1, wherein
the high-resistance part has a resistance higher than a resistance of
25 the n-type window layer.
- [3] The solar cell according to claim 1, wherein
the compound semiconductor layer has a recessed surface on its face

on the side opposite to the conductive film, and

the high-resistance part is formed in the vicinity of the recessed surface.

5 [4] The solar cell according to claim 1, wherein
the n-type transparent conductive film is connected with a part of the compound semiconductor layer other than the high-resistance part only via at least either one of the n-type window layer and the high-resistance part.

10 [5] The solar cell according to claim 1, wherein
the high-resistance part contains, as the n-type impurity, at least one element selected from the group consisting of the elements of Group IIa and the elements of Group IIb.

15 [6] The solar cell according to claim 1, wherein
the n-type impurity of the high-resistance part is Zn, Mg, or Ca.

20 [7] The solar cell according claim 1, wherein
the p-type semiconductor crystal of the compound semiconductor layer is a chalcopyrite-structured CuInSe_2 crystal, a chalcopyrite-structured $\text{Cu}(\text{Ga}, \text{In})\text{Se}_2$ crystal, or a chalcopyrite-structured $\text{CuIn}(\text{S}, \text{Se})_2$ crystal.

25 [8] The solar cell according to claim 1, wherein
the n-type window layer is a ZnO film or a ZnMgO film.

[9] The solar cell according to claim 1, further comprising:
a n-type buffer layer formed between the compound semiconductor layer and the n-type window layer, the n-type buffer layer having an aperture

that is connected with the aperture of the n-type window layer.

[10] The solar cell according to claim 9, wherein
the n-type buffer layer is a Zn(O,OH) film or a Zn(O,S,OH) film.

5

[11] The solar cell according to claim 1, wherein
the n-type transparent conductive film is an ITO film, a SnO₂ film, an
In₂O₃ film, a ZnO:Al film, or a ZnO:B film.

10 [12] The solar cell according to claim 1, wherein
the substrate is a glass substrate containing at least one alkali metal
element selected from the group consisting of Na, K, and Li, and
a difference between a coefficient of linear expansion of the substrate
and a coefficient of linear expansion of the p-type semiconductor crystal is
15 within a range of not less than $1 \times 10^{-6}/K$ and not more than $3 \times 10^{-6}/K$.

[13] A solar cell producing method comprising the steps of:
forming a conductive film on a substrate;
growing a p-type semiconductor crystal on the conductive film, the
20 p-type semiconductor crystal containing an element of Group Ib, an element
of Group IIIb, and an element of Group VIb;
forming a n-type window layer on the p-type semiconductor crystal,
the n-type window layer having an aperture; and
forming a n-type transparent conductive film on the n-type window
25 layer and on a portion of the p-type semiconductor crystal at the aperture of
the n-type window layer,
the solar cell producing method further comprising the step of doping
an n-type impurity in the p-type semiconductor crystal, in the vicinity of a

surface of the p-type semiconductor crystal under the aperture of the n-type window layer, the doping step being carried out between the step of forming the n-type window layer and the step of forming the n-type transparent conductive film.

5

[14] The solar cell producing method according to claim 13, wherein
in the step of doping the n-type impurity in the p-type semiconductor crystal, an impurity film is formed by depositing the n-type impurity by a vapor deposition method or an evaporation method on the n-type window
10 layer and the portion of the p-type semiconductor crystal that is exposed at the aperture of the n-type window layer, and the n-type impurity in the impurity film is diffused by a heat treatment into the portion of the p-type semiconductor crystal.

15 [15] The solar cell producing method according to claim 13, wherein
in the step of doping the n-type impurity in the p-type semiconductor crystal, an impurity film is formed by depositing the n-type impurity by plating on the portion of the p-type semiconductor crystal that is exposed at the aperture of the n-type window layer, and the n-type impurity in the
20 impurity film is diffused by a heat treatment into the portion of the p-type semiconductor crystal.

[16] The solar cell producing method according to claim 14 or 15, further comprising the step of removing the impurity film, the step of removing the
25 impurity film being carried out between the step of doping the n-type impurity in the p-type semiconductor crystal and the step of forming the n-type transparent conductive film.

[17] The solar cell producing method according to claim 13, wherein
in the step of doping the n-type impurity in the p-type semiconductor
crystal, the n-type impurity is implanted by ion implantation into the portion
of the p-type semiconductor crystal via the aperture of the n-type window
5 layer.

[18] The solar cell producing method according to claim 17, wherein
in the step of doping the n-type impurity in the p-type semiconductor
crystal, a heat treatment is carried out additionally, after the n-type impurity
10 is implanted.

[19] The solar cell producing method according to claim 13, further
comprising the step of forming a n-type buffer layer having an aperture, the
step of forming the n-type buffer layer being carried out between the step of
15 growing the p-type semiconductor crystal and the step of forming the n-type
window layer.